FORM PTO-1390 (REV. 9-2001) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	**612.41024X00 filed January 8, 2002**
	U.S. APPLICATION NO. (If known, see 37 CFR 1.5) **10/030222**
INTERNATIONAL APPLICATION NO. **PCT/FR00/02091**	INTERNATIONAL FILING DATE **July 21, 2000**
	PRIORITY DATE CLAIMED **July 27, 1999**

TITLE OF INVENTION
SYSTEM AND METHOD INTENDED FOR THERMAL INSULATION OF A PIPE WITH VEGETABLE FOAM

APPLICANT(S) FOR DO/EO/US
KOHLER, Norbert JARRIN, Jacques REYNES, Pierre MESSAGER, Arnaud

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2)))
   a. ☐ is transmitted hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office(RO/US)
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☒ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information: **Fig. 1, Credit Card Payment Form, PCT Request Form, International Preliminary Examination Report, International Publication No. WO 01/07823, International Search Report w/English translation**

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/030222	PCT/FR00/02091	612.41024X00

21. The following fees are submitted:	CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492(a) (1) - (5)):		
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1040.00**		
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**		
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$740.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	**$890.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	**$**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total Claims	**20** - 20 =	**0**	x **$18.00**	**$**
Independent Claims	**7** - 3 =	**4**	x **$84.00**	**$336.00**
MULTIPLE DEPENDENT CLAIMS(S) (if applicable)			+ **$280.00**	**$**

TOTAL OF ABOVE CALCULATIONS =	**$1,226.00**
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.	**$**
SUBTOTAL =	**$1,226.00**
Processing fee of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).	**$**
TOTAL NATIONAL FEE =	**$1,226.00**
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property	**$**
TOTAL FEES ENCLOSED =	**$1,226.00**
Amount to be refunded:	**$**
charged:	**$**

a. ☐ A check in the amount of $ _____ to cover the fees is enclosed.

b. ☐ Please charge my Deposit Account No. **01-2135** in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposition Account No. **01-2135**. A duplicate copy of this sheet is enclosed.

d. ☒ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Antonelli, Terry, Stout & Kraus, LLP
1300 North Seventeenth Street
Suite 1800
Arlington, VA 22209
USA

SIGNATURE

Alan E. Schiavelli
NAME

32,087
REGISTRATION NO.

612.41024X00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: KOHLER et al

Serial No.:

Filed: January 8, 2002

For: System And Method Intended For Thermal Insulation Of A Pipe With Vegetable Foam

Group:

Examiner:

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

January 8, 2002

Sir:

Prior to examination on the merits of this application and prior to calculation of the filing fee, please amend the above-identified application as follows:

IN THE CLAIMS:

Please amend the claims to read as follows:

3. (Amended) A method as claimed in claim 1, wherein said volume of vegetable foam is solubilized by an aqueous fluid so as to allow free pulling of said internal enclosure.

5. (Amended) A method as claimed in claim 1, wherein the average size of the particles is below 5 mm.

6. (Amended) A method as claimed in claim 1, wherein said vegetable foam comprises at least : a flour and/or a non-gelatinized starch, a plasticizer, possibly

another additive, a water content below 10 % and preferably below 5 %.

9. (Amended) An installation as claimed in claim 7, wherein said vegetable foam particles have the following properties : thermal conductivity ranging between 0.03 and 0.06 W/m.°K and at least partial solubility in an aqueous fluid.

10. (Amended) An installation as claimed in claim 7, wherein said vegetable foam particles comprise at least : a flour and/or a non-gelatinized starch, a plasticizer, possibly another additive, a water content below 10 % and preferably below 5 %.

11. (Amended) An installation as claimed in claim 7, wherein said space further comprises at least one of the following insulants : silicate foam particles, aerogel foam particles, dry powders.

18. (Amended) A process for preparing a vegetable foam as claimed in claim 16, characterized in that the plasticizer used is glycerol whose incorporation percentage ranges from 1 to 60 %, preferably from 10 to 40 % by weight.

19. (Amended) A process for preparing a vegetable foam as claimed in claim 16, characterized in that the additives are pigments, fungicides, sugars, structuring agents, expanding agents, cellulose fibres, alcohols, whose incorporation percentage ranges from 0 to 99 %, preferably from 0 to 30 % by weight.

20. (Amended) A process for preparing a vegetable foam as claimed in claim 16, characterized in that mixing, heating and expansion consist of baking-two-screw or single-screw extrusion at temperatures ranging between 10°C and 300°C, preferably between 20°C and 250°C.

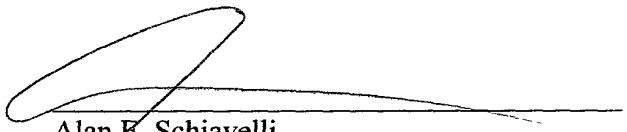
REMARKS

The foregoing amendments are respectfully requested prior to examination on the merits of this application. A marked up copy of the amended claims is attached.

To the extent necessary, applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 612.41024X00), and please credit any excess fees to such deposit account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP



Alan E. Schiavelli
Registration No. 32,087

AES/jla
(703) 312-6600

REWRITTEN MARKED UP COPY

3. (Amended) A method as claimed in ~~any one of the previous claims~~ claim 1, wherein said volume of vegetable foam is solubilized by an aqueous fluid so as to allow free pulling of said internal enclosure.

5. (Amended) A method as claimed in ~~any one of the previous claims~~ claim 1, wherein the average size of the particles is below 5 mm.

6. (Amended) A method as claimed in ~~any one of the previous claims~~ claim 1, wherein said vegetable foam comprises at least : a flour and/or a non-gelatinized starch, a plasticizer, possibly another additive, a water content below 10 % and preferably below 5 %.

9. (Amended) An installation as claimed in ~~any one of claims 7 to 8~~ claim 7, wherein said vegetable foam particles have the following properties : thermal conductivity ranging between 0.03 and 0.06 W/m.°K and at least partial solubility in an aqueous fluid.

10. (Amended) An installation as claimed in ~~any one of claims 7 to 9~~ claim 7, wherein said vegetable foam particles comprise at least : a flour and/or a non-gelatinized starch, a plasticizer, possibly another additive, a water content below 10 % and preferably below 5 %.

11. (Amended) An installation as claimed in ~~any one of claims 7 to 10~~ claim 7, wherein said space further comprises at least one of the following insulants : silicate foam particles, aerogel foam particles, dry powders.

18. (Amended) A process for preparing a vegetable foam as claimed in ~~any one of claims 16 or 17~~ claim 16, characterized in that the plasticizer used is glycerol whose incorporation percentage ranges from 1 to 60 %, preferably from 10 to 40 % by

weight.

19. (Amended) A process for preparing a vegetable foam as claimed in ~~any one of claims 16 to 18~~ claim 16, characterized in that the additives are pigments, fungicides, sugars, structuring agents, expanding agents, cellulose fibres, alcohols, whose incorporation percentage ranges from 0 to 99 %, preferably from 0 to 30 % by weight.

20. (Amended) A process for preparing a vegetable foam as claimed in ~~any one of claims 16 to 19~~ claim 16, characterized in that mixing, heating and expansion consist of baking-two-screw or single-screw extrusion at temperatures ranging between 10°C and 300°C, preferably between 20°C and 250°C.

10/030222

JC13 Rec'd PCT/PTO 08 JAN 2002

ABSTRACT

SYSTEM AND METHOD INTENDED FOR THERMAL INSULATION OF A PIPE WITH VEGETABLE FOAM

- The present invention relates to a thermal insulation installation and method wherein a volume (10) defined by the space contained between a first enclosure (5) interior to a second enclosure (3) is filled with vegetable foam particles. In a variant, the enclosures consist of a string of pipes placed in a well.

- The invention also relates to a vegetable foam consisting of at least a flour and/or a non-gelatinized starch, a plasticizer, and whose water content is below 10 %.

10/030222
JC13 Rec'd PCT/PTO 08 JAN 2002

1/prts

FIELD OF THE INVENTION

The present invention relates to an installation and to a method intended for thermal insulation, notably of a pipe, by means of vegetable foams. The invention also relates to these vegetable foams having notably characteristics specific to the present application, and their preparation processes.

A suitable field of application of the present invention is the transportation of hydrocarbons produced in wells drilled in the ground. In general, a wellbore is cased over the total length thereof by means of steel pipes or casings. This string is cemented, restoration of communication with the reservoir rock being performed by drilling or perforations. The effluent produced by the reservoir rock is taken up to the surface by means of another tubular string or production tubing placed in the well. This layout thus creates an annular space between the production tubing and the inside of the casing string. It is clear that the pressure and temperature conditions of the effluents evolve as it flows through the production string. It is well-known that pressure and/or temperature variations can be harmful to a proper flow, for example because of paraffin deposits, formation of hydrate crystals or of other mineral or organic deposits resulting from a precipitation. Furthermore, during production of viscous crude, the action of temperature and/or pressure variations can lead to a high viscosity increase which makes pumping and transportation difficult. One solution allowing to overcome these problems consists in thermally insulating the production string so as to control the temperature of the effluent.

BACKGROUND OF THE INVENTION

Several thermal insulation techniques are currently known. The string can be insulated by using tubings comprising an insulating material deposited or fastened outside the tubings. This method is very expensive and the tubings are difficult to handle. The annulus can also be filled with a more or less insulating fluid, gelled gas oil, or rigid foam manufactured in situ. Liquids are not very good insulants, gels are delicate to use in operation and not very temperature stable, manufacture of rigid foams is difficult to control and setting them into the annulus blocks the tubing string in the well, thus preventing complete withdrawal of the string. In fact, it is common to have to pull the whole string of production tubings during production of a well, for example as a result of damage, clogging, or for servicing operations on downhole equipments or installations. In the case of solids present in the annulus, removal or elimination thereof must remain possible.

Document FR-2,536,386 describes a new material intended for thermal insulation of production wells, consisting of an alkaline metal silicate foam which theoretically affords a double advantage : it can be manufactured in situ and it can solubilize in water. In reality, as a result of control difficulties, notably relative to the evolution of the chemical reactions at the bottom of a well, the foam formed is quite heterogeneous and it takes a long time to dissolve.

Document FR-2,741,420 describes a thermal insulation system from an aerogel. This product is expensive and relatively complex to use.

Document EP-087,847 describes a process for preparing a foam from starch gelatinized in the presence of 10 to 30 % water and of an expanding agent such as CO_2

(main characteristic of this foam). This foam however has two major drawbacks, the preliminary processing of the starch (starch gelitinization) and its high water content, which do not allow to use it in wells as a thermal insulant. Furthermore, no application in the field of transportation of hydrocarbons produced in wells drilled in the ground is mentioned.

SUMMARY OF THE INVENTION

The present invention thus relates to a thermal insulation method wherein a volume defined by the space contained between a first enclosure interior to a second enclosure is filled with vegetable foam particles.

The volume thus defined can be an annular space defined by the outside of a pipe placed in another pipe.

The volume of vegetable foam can be solubilized by means of an aqueous fluid so as to allow free pulling of the internal pipe.

The aqueous fluid can be about 1N soda.

The foam particles can have an average size below 5 mm.

The vegetable foam can comprise at least : a flour and/or a non-gelatinized starch, a plasticizer, possibly another additive, a water content below 10 % and preferably below 5 %.

The invention also relates to an installation consisting of a first enclosure placed in a second enclosure. The space contained between the two enclosures comprises a volume of vegetable foam particles used as a thermal insulant.

The enclosures can consist of a string of tubings intended for transportation of a petroleum effluent, placed in another pipe, a well for example.

The vegetable foam particles can have the following properties : thermal conductivity ranging between 0.03 and 0.06 W/m.°K and an at least partial solubility in an aqueous fluid.

The vegetable foam particles can comprise at least : a flour and/or a non-gelatinized starch, a plasticizer, possibly another additive, a water content below 10 % and preferably below 5 %.

The space between the two enclosures can also comprise at least one of the following insulants : silicate foam particles, aerogel foam particles, dry powders.

The invention also relates to a vegetable foam consisting of at least a flour and/or a non-gelatinized starch, one or more plasticizers and possibly one or more additives, and whose water content is below 10 %, preferably of the order of 5 %.

A vegetable foam according to the invention is characterized by the following properties :

- thermal conductivity ranging between 0.03 and 0.06 W/m.°K
- and solubility in an aqueous fluid.

The invention also comprises a process for preparing a vegetable foam, characterized in that it consists in :

- mixing a flour and/or starch with one or more plasticizers, and possibly one or more additives,

- heating the mixture,
- expanding the mixture so as to obtain a foam whose water content is below 10 % and preferably of the order of 5 %.

The preparation parameters relative to baking-extrusion on BC45 can be as follows :

- Material flow rate (kg/h) : 1 to 200,
- % water added : 0 to 10,
- Temperature (°C) : 20 to 300,
- Screw speed (rpm) : 5 to 600.

The plasticizer used can be glycerol whose incorporation proportion can range from 1 to 60 % by weight, preferably from 10 to 40 %.

The additives can be pigments, fungicides, sugars, structuring agents, expanding agents, cellulose fibres, alcohols, whose incorporation proportion can range from 0 to 99 %, preferably from 0 to 30 % by weight.

Mixing, heating and expansion can consist of baking-two-screw or single-screw extrusion at temperatures ranging between 10 and 300°C, preferably between 20 and 250°C.

The « vegetable foam » type particles used within the scope of the present invention are defined as follows :

- type I consisting of at least one cereal flour with at least one plasticizer and possibly one or more allowable additives,

- type II consisting of at least one non-gelatinized cereal starch with at least one plasticizer and possibly one or more allowable additives.

It can be reminded that the term « cereal flour » used in the invention describes vegetable substances coming from cereals whose compositions, according to the various base ingredients, are as follows (percentage by weight) :

- water content below 20 %, preferably ranging between 10 and 15 %,
- carbohydrated compounds content below 85 %, preferably ranging between 50 and 80 %, whose starch content is below 80 %, and preferably ranging between 60 and 75 %,
- proteins content below 30 %, preferably ranging between 5 and 15 %,
- fatty acids content below 10 %, preferably ranging between 0.5 and 5 %,
- minerals content below 5 %, preferably ranging between 0.5 and 2 %,
- fibres content below 20 %, preferably ranging between 5 and 10 %.

The terms carbohydrated compounds, proteins, fatty acids, minerals and fibres designate the multiple products and molecules conventionally described by many reference authors in the field of cereal substance compositions. The following document can be mentioned by way of example : « La composition des aliments. Tableaux des valeurs nutritives », Souci/Fachmann/Kraut - 5th Edition - CRC Press.

The table hereafter gives, by way of example, cereal flours that can be used according to the invention : wheat flour (type T55), corn flour and whole wheat flour.

	Water	Starch	Fibres	Proteins	Fatty acids	Rest
T55 wheat flour	13.7 %	70.6 %	4.1 %	9.84 %	1.13 %	0.63 %
Whole wheat flour	13.2 %	58.16 %	10.3 %	11.73 %	2 %	4.61 %
Corn flour	12 %	66.29 %	9.42 %	8.31 %	2.82 %	1.16 %

As regards starch, which is an important element in a flour, it consists of a mixture of two glucose polymers : amylose and amylopectin. The ratio between these two molecules is different according to the cereals and the varieties, as can be seen in the table hereafter for native wheat and corn and two types of corn varieties.

	Native wheat	Native corn	Waxy type corn	High amylose type corn
% amylose	25	27	0	55-75
% amylopectin	75	73	100	25-45

It can be noted that the amylose/amylopectin ratio can be modified by genetic modifications from natural strains.

For the vegetable foams according to the invention, one or more well-determined cereal varieties can be selected so that, for example, the amylose/amylopectin ratio is the most favourable to obtain the end product according to the use considered.

The cereal wheats or the starch used in the invention can undergo various operations prior to being mixed with the other foam constituents (plasticizers and additives). These operations can be for example :

- drying with a final percentage below 15 %, and preferably ranging between 1 and 3 %, and/or

- crushing with a final grain size ranging between 0.1 and 2000 μm, and/or
- screening, and/or
- turbo-separation.

The percentage by weight of flours and/or starch incorporated to the vegetable foams can range between 1 and 99 %, preferably between 40 and 75 %.

The main purpose of the plasticizers used in the invention is to favour plastification of the starch present in the vegetable matter selected. These plasticizers can be, for example, urea, water or glycerol. The percentage by weight of plasticizers incorporated can range from 1 to 60 %, preferably from 10 to 40 %.

The additives used for obtaining the foams can be of different natures. The following can be mentioned by way of example :

- pigments,
- fungicides,
- sugars,
- structuring agents, melamine for example,
- expanding agents,
- cellulose fibres : cellulose, brans of cereal origin, wood, etc.,
- alcohols.

The percentage by weight of additives incorporated can range from 1 to 60 %, preferably from 1 to 30 %.

The vegetable foams according to the invention have the advantage of being prepared by means of a continuous process. This process allows to mix, to heat and to

expand the ingredients in order to obtain foams that can be advantageously used according to the invention. The temperatures range between 10°C and 300°C, preferably between about 20°C and 250°C. Advantageously, mixing, heating and expanding the vegetable products consist in baking-two-screw or single-screw extrusion. This operation can be carried out in a BC 45 type cooker-extruder marketed by the CLEXTRAL company.

The parameters relative to baking-extrusion with a BC 45 device are given in the following table.

	Material flow rate (kg/h)	Water added (%)	Temperature (°C)	Screw speed (rpm)
Minimum	1	0	20	5
Maximum	200	10	300	600

Advantageously, after expansion, the foams are cooled and cut out by means of any suitable technique in order to obtain particles of a length and/or size suited for optimum use. For applications in annuluses between pipes, the particles preferably have an average size below 5 mm, for example in the shape of a disk, a cylinder, a cube.

Characterization tests have been carried out on a foam prepared according to the specifications mentioned above. It comes in the shape of small cylinders, for example, whose height is substantially equal to the diameter.

A conductivity measurement has first been carried out by means of the Rapid K conductimeter. The table below shows that the 0.038 W/m.°K thermal conductivity measured on the vegetable foam particles is comparable to the conductivity of

polysilicate foam, and much lower than that of a gas oil gel, a solution currently used in wells.

Solubility tests have been carried out from 1 g foam dispersed under stirring in 100 ml liquid. It can be observed that the foam is totally soluble in 1N soda, which attests to its superiority in relation to polysilicate foams which are only partially soluble in 4N soda. These foams therefore have the advantage of allowing free pulling of the tubing.

Thermal stability tests carried out in a drying oven show that the weight loss of these foams is respectively 8 % at 70°C and 27 % at 100°C after being heated for 670 hours (28 days). For these two temperatures and after 28 days, the thermal conductivity of the foams is respectively 0.049 and 0.050 W/m.°K, which remains much below the conductivity values of an industrial insulant such as gas oil. The weight loss can be reduced with foam qualities allowing a low water content, for example below 5 %.

Table : Comparative properties of various insulants

Insulating product	Thermal conductivity in W/m.°K	Removal or elimination
Natural vegetable foam	0.038	Dissolution with 1N soda
Polysilicate foam	0.035	Partial dissolution with 4N soda
Gas oil gel	0.180	Dilution and pumping

BRIEF DESCRIPTION OF THE DRAWING

Other features and advantages of the present invention will be clear from reading the description hereafter of non limitative examples illustrated by the sole figure

diagrammatically showing an oil well equipped with a production string insulated according to the method of the invention.

DETAILED DESCRIPTION

The figure diagrammatically shows, in sectional view, an oil well 1 intended for production of hydrocarbons contained in reservoir rock 2. The wellbore is cased by a string of tubings 3. A series of perforations 4 restores layer/hole communication so that the hydrocarbons can flow as shown by the arrows in the figure. A production string 5, generally consisting of an assembly of about 10-m long tubular elements, is lowered into the well so that the end thereof is close to the perforated zone 4 of casing 3. The upper end of production string 5 is conventionally suspended from the elements of wellhead 6. A series of valves 7 controls the flow rate of the effluent in surface collection pipe 8.

A sealing means or packer 8 insulates the annular space 10 of space 11 filled by the hydrocarbons. Annular space 10 is totally or partially filled by vegetable foam particles as described so as to form an insulating lining at a given depth and over a given height.

Production string 5 preferably comprises a circulation valve 12 which, when it opens, generally by means of a sliding sleeve, allows circulation of a fluid through the inner space of the production tubing to the surface through annulus 10, or in the opposite direction. This circulation valve can be used for driving the insulating foam particles out of the well or for dissolving said particles by soaking them in a suitable fluid.

The invention is not limited to oil wells, it is clear that it can also apply to any equivalent systems, for example double-walled pipelines (pipe-in-pipe) or double-walled reservoir shells.

Furthermore, a mixture consisting of one or more other thermal insulants and of the vegetable foams according to the invention can also be suitable for the thermal insulation method of the invention. Examples of other thermal insulants are aerogel particles, polysilicate foam particles, dry powders, vermiculite for example, fly ashes, carbon black.

A process allowing to obtain a type I foam is described hereafter by way of example.

The cereal flour used in this example is a type T55 wheat flour dried to about 2 % water.

The plasticizer used is glycerol with a 99.9 % purity.

The table hereunder gives the main parameters used during baking-extrusion to obtain the vegetable foams according to the invention.

Temperature (°C)	140
Material flow rate (kg/h)	35
Water added (l/h)	3
Screw speed (rpm)	80

The foams obtained are directly expanded as they leave the cooker-extruder. The particles are about 1 to 2 mm long and 1 to 2 mm in diameter.

These foams eventually contain about 65 % dry cereal matter, 30 % glycerol (% by weight) and 5 % water.

CLAIMS

1) A method intended for thermal insulation, characterized in that a volume defined by the space contained between a first enclosure interior to a second enclosure is filled with vegetable foam particles.

2) A method as claimed in claim 1, wherein said volume is an annular space defined by the outside of a pipe placed in another pipe.

3) A method as claimed in any one of the previous claims, wherein said volume of vegetable foam is solubilized by an aqueous fluid so as to allow free pulling of said internal enclosure.

4) A method as claimed in claim 3, wherein said fluid is about 1N soda.

5) A method as claimed in any one of the previous claims, wherein the average size of the particles is below 5 mm.

6) A method as claimed in any one of the previous claims, wherein said vegetable foam comprises at least : a flour and/or a non-gelatinized starch, a plasticizer, possibly another additive, a water content below 10 % and preferably below 5 %.

7) An installation consisting of a first enclosure placed in a second enclosure, characterized in that the space contained between said enclosures comprises a volume of vegetable foam particles used as a thermal insulant.

8) An installation as claimed in claim 7, wherein said enclosures consist of a string of tubings intended for transportation of a petroleum effluent placed in another pipe, a well for example.

9) An installation as claimed in any one of claims 7 to 8, wherein said vegetable foam particles have the following properties : thermal conductivity ranging between 0.03 and 0.06 W/m.°K and at least partial solubility in an aqueous fluid.

10) An installation as claimed in any one of claims 7 to 9, wherein said vegetable foam particles comprise at least : a flour and/or a non-gelatinized starch, a plasticizer, possibly another additive, a water content below 10 % and preferably below 5 %.

11) An installation as claimed in any one of claims 7 to 10, wherein said space further comprises at least one of the following insulants : silicate foam particles, aerogel foam particles, dry powders.

12) A vegetable foam characterized in that it consists of at least a flour and/or at least a non-gelatinized starch, one or more plasticizers and possibly one or more additives, and the water content is below 10 %, preferably of the order of 5 %.

13) A vegetable foam characterized in that it consists of at least a flour, one or more plasticizers and possibly one or more additives, and the water content is below 10 %, preferably of the order of 5 %.

14) A vegetable foam characterized in that it consists of at least a non-gelatinized starch, one or more plasticizers and possibly one or more additives, and the water content is below 10 %, preferably of the order of 5 %.

15) A vegetable foam characterized by the following properties :

- thermal conductivity ranging between 0.03 and 0.06 W/m.°K
- solubility in an aqueous fluid.

16) A process for preparing a vegetable foam, characterized in that it consists in :

- mixing a flour and/or starch with one or more plasticizers, and possibly one or more additives,
- heating the mixture,
- expanding the mixture so as to obtain a foam whose water content is below 10 %, preferably of the order of 5 %.

17) A process for preparing a vegetable foam as claimed in claim 16, characterized in that the parameters relative to baking-extrusion on BC 45 are :

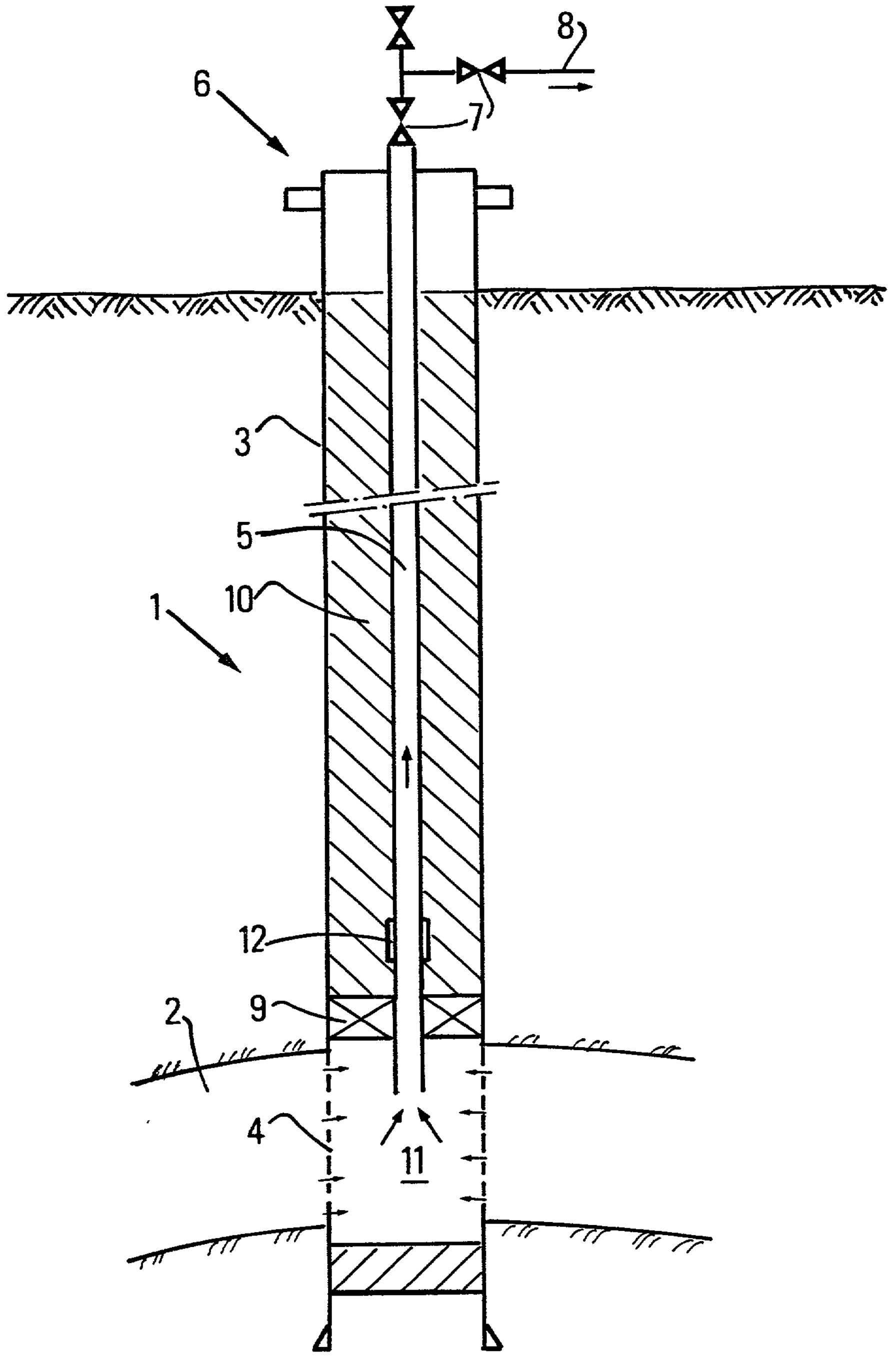
- Material flow rate (kg/h) : 1 to 200,
- % water added : 0 to 10,
- Temperature (°C) : 20 to 300,
- Screw speed (rpm) : 5 to 600.

18) A process for preparing a vegetable foam as claimed in any one of claims 16 or 17, characterized in that the plasticizer used is glycerol whose incorporation percentage ranges from 1 to 60 %, preferably from 10 to 40 % by weight.

19) A process for preparing a vegetable foam as claimed in any one of claims 16 to 18, characterized in that the additives are pigments, fungicides, sugars, structuring

agents, expanding agents, cellulose fibres, alcohols, whose incorporation percentage ranges from 0 to 99 %, preferably from 0 to 30 % by weight.

20) A process for preparing a vegetable foam as claimed in any one of claims 16 to 19, characterized in that mixing, heating and expansion consist of baking-two-screw or single-screw extrusion at temperatures ranging between 10°C and 300°C, preferably between 20°C and 250°C.



#4

4536/00/JPN

Attorney's Docket No.:

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that: my residence, post office address and country of citizenship are as stated below, next to my name; I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled :

SYSTEM AND METHOD INTENDED FOR THERMAL INSULATION OF A PIPE WITH VEGETABLE FOAM

the specification of which

___ is attached hereto.

_X_ was filed on July 21, 2000 as
United States Application Number
or PCT International Application Number N°FR00/02.091 _____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits, under 35 U.S.C. 119(a)-(d) or 365(b), of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed?	
99/09.769	FRANCE	27 JUL 1999	yes	
(Number)	(Country)	(Foreign Filing Date)	Yes	No
(Number)	(Country)	(Foreign Filing Date)	Yes	No

I hereby claim the benefit, under 35 U.S.C. 119(e), of any United States provisional application(s) listed below:

(Application Number)	Filing Date
(Application Number)	Filing Date

I hereby claim the benefit, under 35 U.S.C. 120, of any United States application(s) listed below:

(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint: Donald R. Antonelli, Reg. No. 20,296; Melvin Kraus, Reg. No. 22,466; William I. Solomon, Reg. No. 28,565; Gregory E. Montone, Reg. No: 28,141; Ronald J. Shore, Reg. No. 28,577; Donald E. Stout, Reg. No. 26,422; Alan E. Schiavelli, Reg. No. 32,087; James N. Dresser, Reg. No. 22,973; Carl I. Brundidge, Reg. No. 29,621; Paul J. Skwierawski, Reg. No. 32,173; and Robert M. Bauer, Reg. No. 34,487; of ANTONELLI, TERRY, STOUT & KRAUS, LLP with offices located at 1300 North Seventeenth Street, Suite 1800, Arlington, Virginia 22209, my attorneys, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send all correspondence to:

Customer Number 020457
ANTONELLI, TERRY, STOUT & KRAUS, LLP
1300 North Seventeenth Street
Suite 1800
Arlington, VA. 22209

Direct all telephone calls and faxes to:
TEL: (703) 312-6600
FAX: (703) 312-6666

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00
Full Name of Sole/First Inventor KOHLER Norbert
Inventor's Signature Norbert Kohler Date December 21/2001
Residence 10 Place Verdi, 78670 VILLENNES SUR SEINE, FRANCE FRX
(City, State)
Citizenship Belgian
(Country of Citizenship)
Post Office Address 10 Place Verdi, 78670 VILLENNES SUR SEINE, FRANCE

2-00
Full Name of Second/Joint Inventor JARRIN Jacques
Inventor's Signature Jacques Jarrin Date December 21, 2001.
Residence 5, rue de Stalingrad, 92000 NANTERRE, FRANCE FRX
(City, State)
Citizenship French
(Country of Citizenship)
Post Office Address 5, rue de Stalingrad, 92000 NANTERRE, FRANCE

3-00

Full Name of Third/Joint Inventor REYNES Pierre
Inventor's Signature Pierre Reynes Date January 7, 2002
Residence 10 Boulevard de la République, 63200 RIOM, FRANCE FRX
(City, State)
Citizenship French
(Country of Citizenship)
Post Office Address 10 Boulevard de la République, 63200 RIOM, FRANCE

4-00

Full Name of Fourth/Joint Inventor MESSAGER Arnaud
Inventor's Signature Arnaud Messager Date January 7, 2002
Residence 9 rue Soubrany, 63200 RIOM, FRANCE FRX
(City, State)
Citizenship French
(Country of Citizenship)
Post Office Address 9 rue Soubrany, 63200 RIOM, FRANCE

Full Name of Fifth/Joint Inventor
Inventor's Signature __________ Date __________
Residence
(City, State)
Citizenship
(Country of Citizenship)
Post Office Address

Full Name of Sixth/Joint Inventor
Inventor's Signature __________ Date __________
Residence
(City, State)
Citizenship
(Country of Citizenship)
Post Office Address

Full Name of Seventh/Joint Inventor
Inventor's Signature __________ Date __________
Residence
(City, State)
Citizenship
(Country of Citizenship)
Post Office Address

Full Name of Eighth/Joint Inventor
Inventor's Signature __________ Date __________
Residence
(City, State)
Citizenship
(Country of Citizenship)
Post Office Address

Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by 991.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

(e) In any continuation-in-part application, the duty under this section includes the duty to disclose to the Office all information known to the person to be material to patentability, as defined in paragraph (b) of this section, which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

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Application

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Application Number	
Filing Date	January 8, 2002
First Named Inventor	KOHLER, Norbert
Group Art Unit	
Examiner Name	
Attorney Docket Number	612.41024X00

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Signature		
Date	January 8, 2002	

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